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A MODEL FOR THE DEMAND FOR HIGHER EDUCATION IN THE UNITED STATES, 1919-64.

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STATISTICAL DEMAND ANALYSIS, WHICH EMPHASIZES THE INFLUENCE OF RELATIVE PRICES AND REAL INCOME UPON THE DEMAND FOR A COMMODITY, WAS USED TO DEVELOP A MODEL OF THE DEMAND FOR HIGHER EDUCATION. THE STUDY IS BASED ON THE FACT THAT COLLEGE ENROLLMENT REPRESENTS THE PURCHASE OF BOTH A PRODUCER AND CONSUMER DURABLE, AND IS AN ACT OF INVESTMENT. INVESTMENT RISKS APPEAR IN TWO FORMS--(1) THE RISK OF FAILURE TO COMPLETE THE EDUCATION, AND (2) THE RISK THAT EDUCATION, EVEN THOUGH COMPLETED, WILL NOT YIELD THE EXPECTED INCOME RETURN. ONLY THOSE REGARDED AS POTENTIAL INVESTORS, GRADUATE STUDENTS AND STUDENTS ENROLLED IN 2-YEAR INSTITUTIONS ARE EXCLUDED FROM THE STUDY. FROM THE ANALYSES MADE, THE PRINCIPLES THAT LIMIT EDUCATIONAL DEMAND BELOW THE TOTAL OF THOSE ELIGIBLE TO ENROLL WERE DEDUCED TO BE (1) THOSE INDIVIDUALS WHOSE EXPECTED RATE OF RETURN OVER COST IS ZERO, OR BELOW, WILL HAVE A ZERO ENROLLMENT DEMAND, AND (2) ENROLLMENT DEMAND IS DIMINISHED BY EXCLUSION OF THOSE WHO MUST RELY ON LOANS TO ENROLL. THE MODEL DERIVED AS A MEASURE OF DEMAND WAS--THE RATIO OF ENROLLEES TO ELIGIBLES FOR A GIVEN YEAR IS A FUNCTION OF THE REAL DISPOSABLE INCOME PER HOUSEHOLD AND OF THE AVERAGE REAL TUITION IN THAT YEAR. (AL)

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April, 1966

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I.

The demand for higher education is a subject that has been little explored by economists. Most studies of the rate of return on educational investment simply assume that individuals make decisions to purchase their educations on the basis of rational calculations of costs and benefits. But, as Blaug has pointed out,[1] there is little evidence that people do in fact behave in this fashion. Becker has argued that attendance rates among nonwhites, women, and rural persons (as compared to all male whites) are consistent with the lower rates of return earned by these groups.[2] Nevertheless, the rates of return and the college attendance rates in the data used by Becker refer to different cohorts; hence, there is still no direct evidence that cohorts enroll in college in response to the rates of return expected by the same cohorts.

While we know of no simple way of relating college attendance rates to personally expected rates of return from investment in higher education, we do believe it possible to shed some light on this matter by analyzing time series data on enrollments, incomes, and educational costs, using the tools of conventional demand theory.

The paper begins with a discussion of the suitability of enrollment ratios as a measure of the demand for higher education. The succeeding

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[1] Mark Blaug, "The Rate of Return on Investment in Education in Great Britain," The Manchester School, September, 1965, pp. 208-11.

[2] Gary Becker, Human Capital: A Theoretical and Empirical Analysis, With Special Reference to Education (Columbia University Press, 1964), pp. 90-103.

sections outline and test elements in a theory of demand applied to higher education during the period 1919-1964.

II.

The U. S. Office of Education has, for a number of years, collected statistics on college enrollments. The Office usually presents its findings in the form of ratios of enrollments to various population bases. (See Table I) While the Office does not say so, we believe these ratios are intended to be indices of the intensity or pervasiveness of the demand for higher education within the relevant population groups.[3] But, as measures of demand, the ratios computed by the Office have several defects.

First, aggregation of enrollments involves the assumption of homogeneity of educational demand--the assumption that, from the point of view of buyers of higher education, different kinds of educational experiences are perfect substitutes. Yet, an engineering education differs from an education in the classics, and the motive underlying the purchase of each of these educations is different. Nevertheless, we are prepared to live with the assumption of homogeneity. Most students probably enter institutions of higher education without particular plans. As they proceed beyond their freshman year, students make more specific curriculum choices; but, this does not deny that most students probably value the Bachelor degree more than the particular subject matter represented by the degree.

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[3] It is hard to impute any other meaning to such ratios. We might also note that these ratios are widely used as demand indices in the literature on higher education.

Table 1

Resident Degree Credit Enrollment in Institutions of Higher Education as Related To Various Age Groups, United States, 1919-61
(Note: All ratios multiplied by 100)

Year	Ratio of Total Enrollment to:		Ratio of Undergraduate Enrollment to:
	Population 18 - 21	Population 18 - 24	Population 18 - 21
1919 - 1920	8.09	4.66	7.88
1929 - 1930	12.42	7.20	11.89
1939 - 1940	15.59	9.08	14.49
1949 - 1950	29.58	16.50	26.94
First term of academic year:			
1959 - 1960	34.86	20.49	31.15
1961 - 1962	36.37	21.98	32.48

Source: Digest of Educational Statistics, 1964, p. 76. U. S. Office of Education. U. S. Department of Health, Education, and Welfare.

The enrollment ratio is also defective because it assumes that a particular age group -- 18-21, or 18-24 -- is the relevant population from which enrollment demand is generated. We are sympathetic with the Office of Education in this matter; it is not reasonable to include the whole population in the relevant group. Some age groups are more likely to enroll than others. A compositional shift of the population toward or away from these groups would lead to irrelevant shifts in the ratio. Nevertheless, use of a restricted age group does imply that the age distribution of enrolled students remains constant over time. This assumption also leads to bias, since the age distribution surely shifts over time. In the absence of information on student age distributions over time, however, we too are willing to live with this assumption.

But we cannot live with a third defect. The enrollment ratio is a proper measure of the intensity of pervasiveness of demand only if it reflects acts of choice by students (and/or their parents). We must exclude from the relevant population two specific groups who cannot choose: people without the qualifications for admission into institutions of higher education, and people who cannot enroll by reason of being wholly and irrevocably committed (for the period relevant to the measurement) to some other activity. The denominators of the ratios computed by the Office of Education do not exclude these two groups.

Who should be counted as qualified? American institutions of higher education are highly diversified in their entrance requirements. No single statistical measure of minimum qualifications for admission into the system as a whole seems possible. Nevertheless, we have settled upon one qualification which, while not universal, is probably more satisfactory than any

other: a high school diploma or its equivalent. Practically, this qualification boils down to the criterion of a high school diploma, since there are no continuous time series which estimate the number of people in various age groups who have the equivalent of a high school diploma.

The second excluded group comprises individuals in a variety of conditions: inmates of penal or other correctional institutions, people institutionalized or immobilized for reasons of health, and members of the armed forces. Members of these groups may possess high school diplomas and fall into the proper age group, but they almost never are in a position to choose to enroll in an institution of higher education. We have no estimates over time of the institutionalized population in the college age group, but we do have estimates over time of the number of people in the armed forces of college age with high school diplomas.[4]

These considerations lead us to include in the denominator of our enrollment ratio only those in the 18-24 age group who possess high school diplomas and who are not in the armed forces. We define this group as the eligible college age population. We recognize the deficiencies of this definition; nevertheless, we believe it is a more useful concept than that of the Office of Education.

Chart I gives the information necessary to make comparisons between the two methods of computing enrollment ratios. For reasons which will be explained below, we have chosen to use resident undergraduate degree enrollments in four-year institutions as the basic numerator. From the chart we draw several conclusions: first, over the period as a whole, trends in

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[4] A discussion of these and other estimates appears in the appendix.

enrollments paralleled trends in the eligible college age population; second, the increase in the ratio of enrollments to the total college age population -- the measure used by the Office of Education -- is mostly explained by the increase in the proportion of eligibles in their population base; third, although the enrollment ratio used by the Office of Education increased by more than four times its 1919 value, a ratio computed by our method would show no change over the period as a whole;[5] finally, fluctuations in the ratio within the period are more clearly revealed by our measure.

The last two points suggest a reconsideration of the forces affecting the demand for higher education. Contrary to the impression given by the ratios published by the Office of Education, there does not appear to have been, historically, an upward shift in the underlying preference for higher education among those who are eligible to acquire it. If any revision has occurred, it is among those who demand a high school diploma. It may be argued, of course, that the demand for high school diplomas is derived from the demand for college enrollments. This we do not deny. We believe, however, that the study of the demand for high school diplomas is of a different character and is complex enough to warrant a separate study. Here, we confine ourselves to the problem of the demand for higher education among those who are in a position to make a choice.

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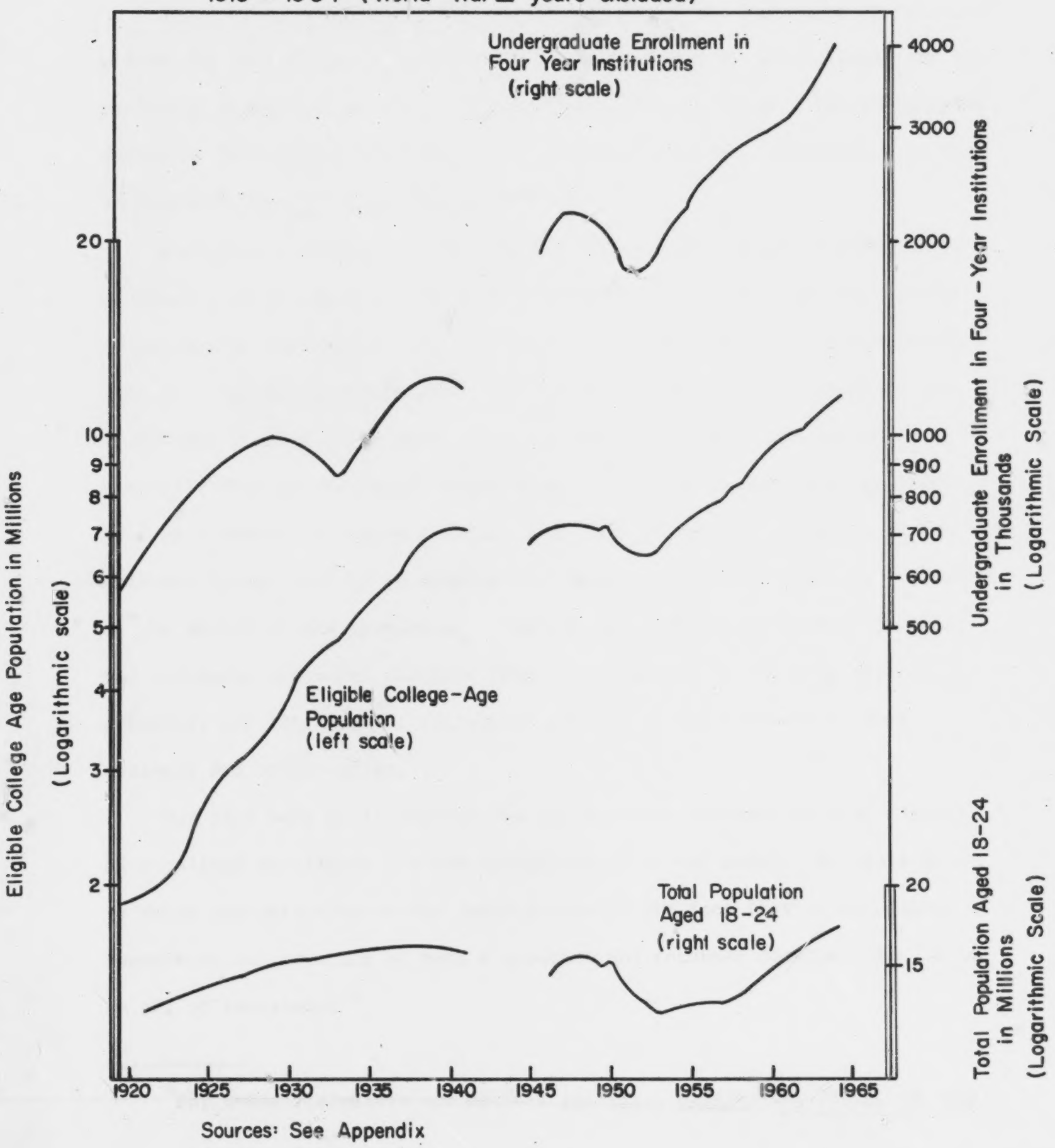
[5] B. A. Jaffe and Walter Adams have found this to be true for a century. Their findings are based upon backward projections from 1940 and 1960 census data on educational levels achieved by various age groups, a method quite distinct from ours. 'Trends in College Enrollment," College Board Review, Winter, 1965.

Chart I Undergraduate Enrollment in Four Year Institutions, Eligible College Age Population, and Total Population Aged 18-24 1919 - 1964 (World War II years excluded)



Sources: See Appendix

III.

Statistical demand analysis, which emphasizes the influence of relative prices and real income upon the demand for commodities, is available for the empirical specification of the demand for higher education. Yet the complex nature of the educational "commodity" requires a careful exploration of the theoretical foundations of the model.

A college enrollment, in particular, is an asset which provides an individual with an expected lifetime monetary income stream superior to the income stream expected without the asset. In this sense, a college enrollment is a durable producer good. At the same time, the enrollment is also a consumer durable whose real output is the extra social and intellectual amenities that an individual might expect to accrue to him over his lifetime as a result of having received a college education. Finally, an enrollment brings with it an additional consumption element which is current to the period of the enrollment. The current consumption element includes the enjoyment a student receives from participating in the many social, athletic, and intellectual activities present on the campuses of most colleges and universities.

Our task here is to examine the implications of these various aspects of a college enrollment for the specification of our model. We shall do so by first concentrating on the implications of the fact that an enrollment represents the purchase of both a producer and consumer durable; that it is an act of investment.[6]

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[6]For other statements see Becker, op. cit., passim, and Blaug, op. cit.

As with any investment, the purchase of an enrollment can be justified only if the present value of the expected stream of benefits -- including both the extra money income and extra direct consumption of social and intellectual amenities -- resulting from the enrollment exceeds the cost of the enrollment. The cost of the enrollment includes direct monetary outlays in the form of differential living costs, tuition, fees, books, etc. and indirect (opportunity) costs which are measured by the loss of income while attending school. Non-monetary costs include the burden of study and, for some students, the pain of being away from home.

The current consumption element in the educational commodity can be introduced through a modification of the concept of cost in relation to an enrollment. Just as we must consider in our calculations the burden of study and similar non-monetary costs so we must net against them the value of those aspects of the life style of a college enrollment -- such as social, athletic, and (even) intellectual activities -- which make up the current consumption element in higher education. While the overall value of the current consumption element cannot be measured directly, we may suppose that the individual has the option to buy substitutes for it outside the college or university in which he is enrolled. If this is true, the value of the current consumption element may be approximately measured by the value of its substitutes in the market. The net cost of an enrollment, therefore, is the sum of the costs defined in the previous paragraph minus the value of the current consumption element as measured by the value of its substitutes.

Because of the inclusion of a current consumption element in the calculation of the cost of an enrollment to the buyer, we would expect the

demand for education to be sensitive to the current price level of consumer goods in general. At the same time, the existence of a real consumption component in the future stream of returns from an investment in education should enhance this sensitivity. Consider an increase in the price level of all consumer goods relative to current tuition charges. Conventional demand analysis would suggest, following the logic of consumer utility maximization, an increase in enrollment arising from the relative price shift and governed by the substitution conditions between the current benefits of college attendance and other current consumption items. Consideration of the durable consumer good aspect of education would add to this the increased enrollment arising from the substitution of the now relatively cheaper future stream of consumption arising from current education for current non-educational consumption.

The two consumption good aspects of enrollment in higher education should both be responsive to real income as well, again following conventional utility theory. At given relative prices (and income elasticities), a rise in real income should lead to an increase in the purchase of enrollments viewed as a source of both current and future consumer satisfactions.

As with other investment models, risk and uncertainty appear in the model of the demand for higher education. Risk appears in two forms: the risk of failure to complete the education and the risk that the education, even though completed, will fail to yield the expected differential income stream.

Students use a number of devices to reduce the first kind of risk. They study light subjects, take easy professors, hire tutors, and choose less demanding schools. Academicians are prone to argue as if these stratagems for reducing the first kind of risk increase the second kind of risk.

We take no firm position on this point. We might parenthetically point out, however, that widespread attempts to reduce risk of the first kind would lead to relative abundance of people with "riskless educations," as opposed to people who have accomplished "risky educations." Other things remaining the same, this should raise the income potential of the latter group in relation to the first. Nevertheless, this possiblity may not be foreseen by those who indulge in risk reduction of the first kind.

The second kind of risk is partially avoidable if students specialize their educations in ways which give them access to relatively riskless occupations -- school teaching for example. Such occupations, however, often yield lower potential lifetime incomes, hence this sort of risk reduction is not entirely costless.

Even if the capitalized value of the expected differential income stream (with due account being taken of risk) should exceed the net cost of an enrollment, lack of finance may still prevent an individual from buying education. Four sources of finance are available: a) the individual's own income or accumulated assets; b) friends' or relatives' incomes or accumulated assets; c) gifts and scholarships from various sources, including educational institutions themselves; and d) loans from various sources, including family, other individuals, educational institutions, governments, and financial institutions. Some individuals will have all four of these sources available to them; others will have fewer, perhaps none.

IV.

From the point of view supplied by the investment approach to theory of the demand for higher education, the aggregate of enrollments in higher education reflects an aggregate of decisions to invest in educational capital. The total number of people with high school diplomas and not irrevocably committed to other activities, at any point in time, is always much larger than the total of those enrolled in institutions of higher education. What prevents the total of enrollments from expanding to its ultimate potential? Why does not everyone who can buy an education invest in one?

A. Assume, first, that there is no problem for any individual in financing an enrollment in higher education. Next, array the total eligible population (regardless of age) according to estimates made by individuals in that population of the expected differential income to be earned per dollar of the cost of enrollment -- i.e., according to the expected rate of return over the cost of an enrollment. Very high rates of return over cost will be expected by very few. Moderate rates will be expected more, and low rates of return will be expected by even more. In other words, as the expected rate of return falls, we should be able conceptually to include more and more of the population in the array. The domain of the expected rate of return should include both very high values and negative values, wherein costs of enrollment exceed expected differential incomes.

We can now deduce the first principle which limits educational demand below the total population of those eligible to enroll. Even assuming away the problem of finance, those individuals for whom the expected rate of return over cost is zero or below will have a zero enrollment demand.

There are several groups in society to whom the first principle is most likely to apply: first, of course, are those who have already received a college degree and who are already enjoying their differential income stream.

The second group includes those who do not possess a degree but for whom the cost of an education would be particularly high and the expected differential income stream low. This group consists mainly of people who are well past the typical college age group. Indeed, it is the rate of return principle which best defines the college age group. Provided he is employed, the older an individual becomes the lower the expected rate of return over the cost of an enrollment is likely to become. This is because seniority unusally brings higher current income and hence higher opportunity costs. (If the individual is married, the subjective value of these costs is likely to be higher also.) Moreover, since the joys of college life are probably much dimished in the senior group, so too will be the consumption deduction we can make from the nonmonetary costs of an enrollment. Finally, age will reduce the expected lifetime income differential. It is therefore no accident that 80 per cent of the undergraduate enrollments fall within the age group below 25 years.[7]

The third group includes those who are subjected to various kinds of discrimination based on sex, race, religion, etc. The expected differential income stream from higher education would for many of these individuals, fall well below enrollment costs. We suspect that this factor

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[7] A. Cartter and R. Farrel, "Higher Education in the Last Third of the Century," Educational Record, Spring, 1965, p. 120.

explains much of the low attendance rate of otherwise qualified women, and of Negroes and other minority groups.[8]

The first principle of demand limitation suggests that variations in enrollment should follow, relatively closely, variations in the size of the younger post high school age group, particularly that group already defined as the eligible college age population. Our data in Chart I are broadly consistent with this prediction. The principle also suggests that the demand for enrollment should further vary (inversely) with the costs of enrollment and (directly) with the expected rate of return over cost.

B. We now dispense with the assumption that educational finance is freely available to all who wish to purchase an enrollment -- i.e., to all those whose expected rate of return over cost is greater than zero. We see immediately that educational demand is further limited to those who can afford it, whose relatives can afford it, whose abilities can capture for them gifts and scholarships, and whose access to borrowing makes it possible to obtain funds at low interest rates.

Indeed, it is the latter factor which, in the American economy, provides the ultimate limitation. Most profitable business investment can be financed with funds from financial markets, since such markets are well organized to serve the business sector. Similar markets are not well

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[8]For example, the rate of return principle may also be used to explain the lower enrollment rates in rural populations, where the expected differential income stream by those who intend to remain in the rural areas is probably below the cost of buying an education. Moreover, urban Negroes in the North have lower enrollment rates than Whites in the North with similar incomes and educational background. (But, this is not ture of the South, perhaps because educated Negroes possess a more protected market for their skills than in the North.) See Becker, op. cit., pp. 90ff.

organized to serve educational investment. The result is that, although an individual may have a prospective rate of return over cost far in excess of going rates of interest in financial markets, he usually will not be able to borrow for his education. As a general (but not universal) principle, therefore, we argue that enrollment demand is further diminished by the exclusion of that group in the eligible college age population which must rely entirely upon loan finance if it is to enroll at all.

C. Our reasoning has left us with a large group in the field of demand -- those whose expected rates of return over cost exceed zero and who do not rely exclusively upon borrowing to finance their educations. This group possesses a variety of sources of finance -- personal income or assets, family income or assets, and gifts and scholarships from individuals and institutions. Individuals in the group will possess these resources in varying degrees. Generally speaking, the lower the income of the family the more dependent will an individual be upon his own or outside resources. Individuals from wealthy families need no personal or outside finance. Individuals from moderately well off families need little personal or outside finance, unless the family is large. We should therefore expect family income to be a factor 8ffe7tin] the size of the enrolled eligible group.

The peculiarities of educational finance suggest that the price of an enrollment is a particularly important variable affecting educational demand. In ordinary investment theory, the price of a business asset affects the demand for the asset only through its effects upon the expected rate of return over cost. The rate of return on an educational investment is similarly affected by the price of the investment. However, because

limited personal sources of finance are so important in educational demand, variations in the price of education may more directly constrain the investment decision. This is especially true for individuals from low income families who must supplement meager family support with personal income or with outside financial help. A rise in the price of higher education may discourage a significant number of these people from investing in education.[9]

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[9]Consider an individual whose personal and family resources place him just within the margin of ability to finance an education. Confronted with a rise in the price of higher education -- say an increase in tuition -- the individual may attempt to increase his personal contribution to his education by finding new (or additional) employment while he is in school. The additional work load tends to increase the psychic costs of education, and, to the extent that the educational work load must be cut, completion of the student's education will be delayed. The delay has the effect of reducing the length of the stream of differential income. Increased work may also have the effect of increasing the risk of successfully completing the education. All of these effects work in the direction of lowering the expected rate of return over cost. Note that this reduction in the rate of return is in addition to the reduction which comes about from the initial increase in the price of the enrollment. If the individual chooses to quit school temporarily in order to work, the effects of educational delay on the expected rate of return are similar to those above.

This analysis assumes the existence of appropriate work opportunities. If such do not exist, the individual will be forced completely to abandon his education. If the educational price increase throws a large number of marginal students onto the market, the effect may be to lower part time earnings and to increase the total amount of work time the student must acquire to finance his education. This should have the effect of lowering the expected rate of return even more.

Another important possibility is that the student may adjust to the increase in price by purchasing an inferior substitute education. Whether or not this choice is made depends upon the student's assessment of the impact of an inferior education on his future differential income stream. If he believes that it is significantly lowered, he might drop out of school rather than buy such an education.

Finally, increased part time employment may substantially reduce the current consumption element in education, which has the effect of increasing the net cost of the educational investment.

V.

Ideally, a statistical test of the theory of enrollment demand would require data on both educational costs and finance as well as expected differential income streams for those eligible to enroll. We do not have all the necessary data, even to an approximation, in the form of continuous time series. We do have, however, some data which can be related to elements in the model. The remaining sections of the paper deal with these data and their treatment.

A. First of all, the financial costs of investing in college enrollment can be represented by an index of tuitions, deflated by the consumer price index.[10] Since this is equivalent to introducing the familar relative price variable of demand analysis, it should also help to explain the demand for enrollments as present and future consumer goods. Similarly, consideration of both producer and consumer good elements in enrollment requires data on both the amounts and sources of funds used to purchase enrollments. Since we have limited information on such matters for the period of time of the study, we have chosen to use estimates of real disposable income per household. We assume that other financial resources vary with this measure.[11]

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[10] It is assumed that other financial costs will tend to vary directly with the consumer price index.

[11] Note, we have not adjusted our income concept for size of family or size of household. While it is true that larger families with given incomes will have more difficulty in sending their children to college, we believe that much of this difficulty is resolved by sending children to less costly schools and by throwing a larger burden of finance upon the student himself. Studies of aggregate enrollment demand are therefore not likely to pick up a large effect from variations in family size. On the dubious statistical relationship between family size and family support for students, see John Lansing, Thomas Lorimer, and Chikashi Moriguchi, How People Pay for College (Survey Research Center, University of Michigan, September 1960), p. 32.

The model also calls for some measure of opportunity costs. We have not included such a variable primarily because it is difficult to find a satisfactory measure. Income from jobs available to high school graduates provides, to be sure, a measure of opportunity costs. To some extent, this measure is already included in our household income variable. Nevertheless, it is still not clear that the availability of such jobs works consistently in the direction of reducing enrollment demand. Students who work draw their incomes from jobs very similar to those available to young high school graduates who do not enroll in college. Hence, an increase in such opportunities may well work to increase, as well as to decrease demand. Because of this ambiguity, we have decided to exclude opportunity costs from the test of the model.

B. A formal statement of the model is given by equation (1):

$$(1) \quad N_t = f_1 (Y_{Ht}, P_t) \cdot f_2 (E_t),$$

where N_t is undergraduate degree enrollment in 4 year institutions in year t, Y_{Ht} is real disposable income per household in year t, P_t is average real tuition in year t, and E_t is the number of 18-24 year old eligibles (the eligible college age population of section II) in year t.

For equation (1) to provide a test of our demand model, certain conditions must be satisfied. The most important is that enrollments not be constrained by instititional restrictions -- e.g., entrance requirments beyond the minimum requirement of a high school diploma. Since N_t is the aggregate of undergraduate enrollments in 4 year institutions, we believe that we can assume such constraints away. In the United States, there is probably an institution of higher education for virtually anyone who both possesses a high school diploma and has the necessary financial resources.

In addition it is necessary to assume: (a) that the enrollment demand function is homogeneous, and (b) that eligibles over the period of the test have not, on the average, changed their tastes for higher education.

. Since we wish to study the ratio of enrollments to eligibles, we can convert equation (1) into the general form

$$(2) \quad \frac{N_t}{E_t} = R_t = f_1 (Y_{Ht}, P_t) \cdot f_2 (1).$$

Note that equation (2) required $f_2 (E_t)$ to be homogeneous of degree one, i.e., changes in E_t do not carry with them compositional changes in the population of eligibles which might affect R_t. Among such changes, for example, would be relative increases in eligible individuals who have strong preferences for higher education. We believe that our statistical results support this assumption concerning $F_2 (E_t)$, and turn now to the estimation of the coefficients.

VI.

A. Chart II presents, on a logarithmic scale, the raw materials for our test: (1) the ratio of undergraduate enrollment in 4 year institutions to eligible 18-24 year olds; (2) real disposable income per household; and (3) an index of tuition costs deflated by the consumers' price index. Note that only nine observations for the period 1927-1963 appear in the Chart. While we have more complete data on the enrollment ratio and real disposable income household, ready estimates of tuition costs are available only for the nine years indicated.[12]

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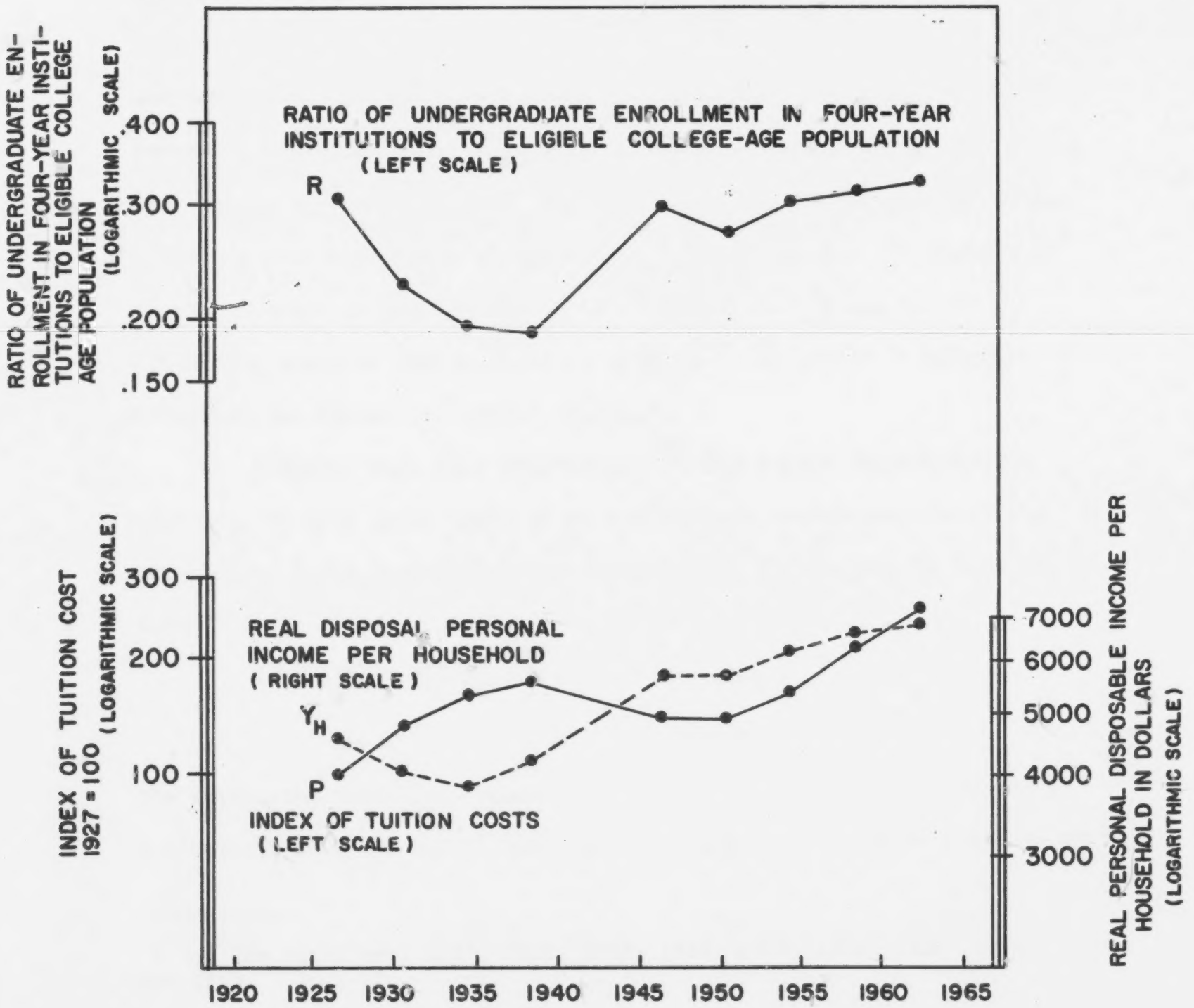
[12] See the appendix for the sources and procedures used in the various estimates.

CHART II RATIO (R) OF UNDERGRADUATE ENROLLMENT IN FOUR-YEAR INSTITUTIONS TO ELIGIBLE COLLEGE AGE POPULATION, INDEX (P) OF TUITION COST, AND REAL PERSONAL DISPOSABLE INCOME PER HOUSEHOLD (Y_h) FOR SELECTED YEARS 1919–1964



SOURCES: SEE APPENDIX

Inspection of Chart II appears to support our hypotheses about the behavior of the demand for education. The enrollment ratio tends to vary directly with variations in real household income. Years for which this is not true are years in which increases in income are accompanied by increases in real tuition costs (1931-35 and 1935-39). In the 1950's and 1960's the enrollment ratio approximated its value in the 1920's. Without our hypothesis concerning the importance of price, this would be puzzling behavior. Real household income was much higher in the 1950's and 1960's than it was during the 1920's, and one would have expected higher income to have a positive effect on the ratio. It appears that the absence of an upward trend in the enrollment ratio during 1919-64 was due to the offsetting negative influence of price against the positive influence of income on the demand for higher education.

B. Although only nine observations[13] were usable for regression analysis, we feel these years to be sufficiently representative of the period as a whole to justify such an analysis. Our regression took the form

(3) $R_t = b\, Y_{Ht}^{\alpha}\, P_t^{\beta}$, or taking logarithus,

(3a) $\log R_t = \log b + \alpha \log Y_{Ht} + \beta \log P_t$

The regression tests our hypotheses 1) that the income effect upon R_t is positive (that $\alpha > 0$) and 2) that the price effect is negative (that $\beta < 0$).

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[13] The years were 1927, 1931, 1935, 1939, 1947, 1951, 1955, 1959, and 1963.

The results are consitent with these hypotheses (standard errors are in parentheses):

$$(3b)\quad \log R_t = .7425 + 1.2036 \log Y_{Ht} - .4404 \log P_t$$

$$(.3702)^* \quad (.1942)^{**} \qquad (.1506)^{***}$$

Coefficient of Multiple Correlation = .9316

$F = 19.701$

$(F_{.01} = 10.92$

Unfortunately, our results do not permit a verification of the hypothesis that R_t was trendless during the 1919-64 period because of the offsetting effects of income and price. To see what would be needed for such a verification, consider the following derivation from equation (3) (assuming $\beta < 0$):

$$(4)\quad \frac{dR}{dtR} = \alpha \frac{dY_H}{dtY_H} - \beta \frac{dP}{dtP}$$

for the ratio to be trendless, $\frac{dr}{dtR}$ must be zero. Hence, substituting $\dot{y}_H$ and $\dot{P}$ as average values of the price changes on the right hand side of (4), we get the following condition for absence of trend in R_t (i.e., R=0):

$$(5)\quad \frac{\dot{P}}{\dot{y}_H} = \frac{\alpha}{\beta}$$

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* Not significant, using $t_{.05}$ in a two-tailed test.

** Significantly greater than zero, using $t_{.005}$ in a one-tailed test.

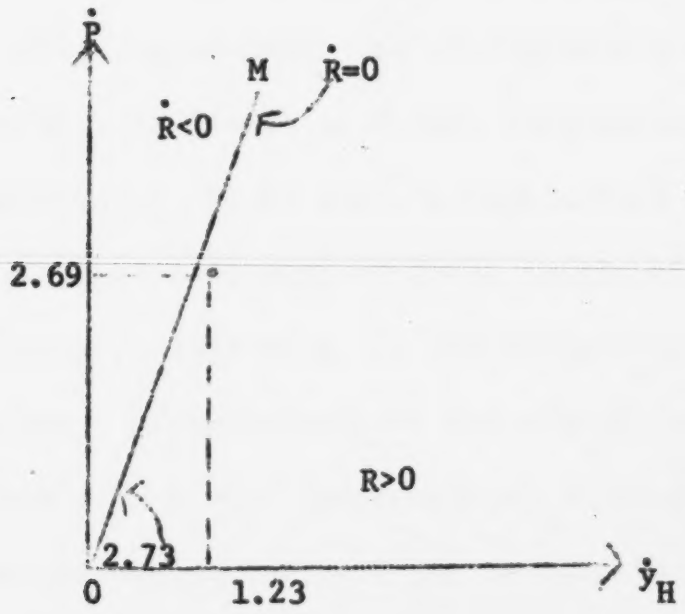
*** Significantly less than zero, using $t_{.025}$ (=2.447) in a one-tailed test.

From the values for α and β in 3(b) we get

$$(6)\quad \dot{p} = 2.73\ \dot{y}_H$$

which, when graphed as in Figure 1, shows the locus of values of $\dot{y}_H$ and $\dot{p}$ necessary to maintain R_t at its initial value. Points above the line depict a falling R_t, while points below the line depict a rising R_t.

Figure 1



If 1.20 and -.44 were in fact true values for α and β, R_t during 1927-63 would have risen according to the values of $\dot{y}_H$ and $\dot{p}$ which obtained during the period (depicted on figure 1). The ratio actually fell during the period. The reason this was not predicted by the study is that line OM is simply a point estimate of the true value of $\frac{\alpha}{\beta}$. With the relatively large standard errors obtained for α and β, we could easily have predicted a rise in R_t, when in fact R_t fell. Hence, while we have not verified our hypothesis, concerning the factors underlying the lack of trend in R_t, we certainly have not rejected it. Indeed, our findings lend support to the conjecture because of α and β possess the necessary signs.

VII.

The estimated demand function -- equation 3(b) -- relates the ratio of undergraduate enrollment in 4 year institutions to the eligibles in the 18-24 year old age group. The calculations exclude both graduate students and students enrolled in 2 year institutions. It is perfectly legitimate to exclude graduate students, since both the age levels and eligiblity requirements for graduate work differ sharply from the age levels and eligibility requirements for undergraduate work.

The exclusion of enrollments in 2 year institutions, however, does not have equal legitimacy. To be sure, a high school diploma is not necessary for matriculation in many of these institutions and vocational training, not ordinary college work, is the objective of many students in these institutions. Nevertheless, we are uncomfortable with the exclusion of enrollments in 2 year institutions, since an enrollment in a 2 year institution can be a substitute for an enrollment in the freshman and sophomore level in a 4 year institution.

Since there is no firm basis for separating students who wish vocational training from those who use a 2 year institution as a substitute for a 4 year school,[14] these students can be treated in only two ways: a) we can exclude them from the enrollment ratio -- as we have done, or b) we can include them in the ratio and seek an interpretation of the change in the ratio.

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[14] The Digest of Educational Statistics contains a breakdown for recent years, but not for earlier ones.

Table 2

Enrollment Ratios for Undergraduates,
Selected Years 1919-64

Year	(1) 2 & 4 Year Institutions	(2) 4 Year Institutions Only	Difference Between (1) and (2)
1919	.328	.323	.005
1927	.320	.305	.015
1931	.246	.225	.021
1939	.201	.179	.022
1947	.332	.299	.033
1951	.309	.276	.033
1952	.321	.277	.044
1953	.339	.290	.049
1954	.348	.299	.049
1955	.356	.305	.051
1956	.377	.323	.054
1957	.382	.326	.056
1958	.382	.326	.056
1959	.371	.316	.055
1960	.368	.311	.057
1961	.372	.310	.062
1962	.384	.317	.067
1963	.393	.326	.067
1964	.395	.326	.069

Source: See appendix

If enrollments in 2 year institutions are included in the numerator of the enrollment ratio, a definite upward trend appears. As Table II indicates, most of the trend appears after the World War II, a period during which the number of junior colleges and community colleges expanded rapidly.

If we choose to regard the bulk of enrollments in 2 year institutions as substitutes for enrollments in the first two years of 4 year institutions, the theory outlined above can easily explain the resulting upward trend in the enrollment ratio. Two year colleges are usually low cost institutions -- in terms of living costs, tuition, and fees -- relative to most competing 4 year institutions. In addition, their closeness to students' homes and their flexible programs make it relatively easier for students to acquire part-time employment. Finally, the presence of many low quality students in these institutions reduces competition for able students. The combination of easier financial burdens plus less intensive competition reduces the risk of the first kind (mentioned above, i.e., the risk of not completing schooling) anticipated by students in the first 2 years of college. Lower costs, easier work opportunities, and reduced risk all work in the direction of increasing the demand for higher education.

VIII.

While most of the limitations of our analysis have been discussed, the relation of our conclusions to rate of return or educational investment studies needs clarification. To some extent our findings help to give a

behavioral foundation to the plausible assumption that people act as if they are investing in educational capital when they choose to enroll in an institution of higher education. Although our evidence is consistent with this assumption, it does not rule out the equally plausible alternative interpretation that enrollment constitutes a consumer good purchase. This ambiguity is clearly reflected in the structure of our model. Use of a deflated tuition index and real income as independent variables could even be viewed as more appropriate to the consumption model than to the investment model. The tuition variable, as deflated, indicates the price of an enrollment (only a part of its cost) relative to the prices of other consumer goods. This relative price variable is obviously related to but not identical with the concept of enrollment cost appropriate to an investment model. Similarly, the real income variable may fit into a consumption theory as well or better than it fits into an investment theory stressing the imperfections of educational finance.

In spite of these limitations we feel that it is useful to explore both of the alternative interpretations. The requirements of educational planning urgently call for the building of a bridge between the relatively crude projections of trend used in the field and the more rigorous but formalistic analysis of educational choice evolving out of studies of investment in human capital. If we are to make more intelligent estimates of the future course of higher education and of the impact of public policy upon that course, we will need not only more and better data, but more sophisticated interpretation and treatment of those data.

Sources and Methods of Statistical Estimates

1. Eligible College Age Population. With certain exclusions, this group was estimated from seven year cumulative totals of high school graduates, beginning with the seventh year prior to the year for which the estimate was required. Historical Statistics of the United States, Colonial Times to 1957 (1960) and the Statistical Abstract of the United States (both published by the U. S. Department of Commerce) provided data for most of the years. Since graduation data appeared biannually for most of these years, it was necessary to interpolate for the missing years. The elements of the cumulative totals were adjusted for death rates. Armed service high school graduates in the 18-24 age group were estimated for 1940 to 1964 by taking the ratio of the seven year cumulative total to the total 18-24 year age group and multiplying the result by the number of 18-24 year servicemen (calculated from the Current Population Report, P-25, #98, U. S. Bureau of the Census). Since age breakdowns of servicemen prior to 1940 are not available, the ratio was multiplied by the total number of enlisted men for these years, on the assumption that this group comprised the bulk of servicemen in the appropriate age group. Official data on the age and educational consumption of the armed forces is extremely sketchy, especially for earlier years. Nevertheless, perusal of Selected Manpower Statistics (Directorate for Statistical Services, Office of the Secretary of Defense, 19 February, 1965) will show that our assumptions are warranted for the years since 1948. As noted in the text, we did not have estimates of the institutionized population in the appropriate age group. More important, we did not exclude people in the 18-24 age group who had already received college

degrees. We do not think that the year to year variation in the enrollment ratio will be much affected by the inclusion of this group. In any event, we had no hard data on the age distribution over time of college graduates.

2. Enrollment Data. Historical Statistics and the Digest of Educational Statistics (op. cit.) provided the basic sources for our estimates. It was necessary to splice together earlier and later enrollment estimates in order to put them on a comparable basis. Those presented in Historical Statistics for 1919-53 were based upon cumulative estimates for the academic year. Those presented in the Digest were for Fall enrollments, 1939, and 1946-64. The Fall enrollment figures wer "blown up" by a factor relating the Fall and cumulative enrollments in four common years. In addition, in order to derive undergraduate enrollments it was necessary to estimate graduate student enrollments for a number of years.

The quality of the pre World War II enrollment figures has long been suspect by students of higher education. Jaffe and Adams (op. cit.), for example, chose to work with backward projections of census data rather than enrollment data for this reason. We did not do so because such a method would not have yielded enough years to be useful for estimating the demand function. In any event, it is striking that our method comes to much the same conclusion about trends in the enrollment ration than Jaffe and Adams came to. Our confidence in the usability of the official enrollment data has been increased by the Jaffee-Adams study.

3. Tuition. The Fact Book on Higher Education (Washington: American Council on Education) publishes various indexes on tuition and other student costs in looseleaf form. We constructed an index weighted by the number of students enrolled in public and private institutions and based upon the

indexes of tuition and fees presented on p. 263 (dated 3/1964) of the Fact Book for 99 private and 33 public institutions. As noted in the text, only 9 years of estimates are available from this source for the period of the study.

4. Disposable Income per Household. Based upon data in Historical Statistics, Statistical Abstract, and the Annual Report of the President's Council of Economic Advisors, 1965 (Washington, 1965). We would have preferred to use estimated income per family, especially in those families where the head is 35-55 years of age and income exceeded a specified minimum. Such detailed income distribution data is not available for the pre War period, except for 1929 and 1935-1936.